

U.S. Participation in the LHC -- Commissioning and Upgrades

Mike Syphers

Fermilab / LARP Collaboration

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Santa Fe, NM

History of LARP

- U.S. LHC Accelerator Project --
 - BNL, FNAL, LBNL collaborate on US hardware for the LHC
 - Deliverables -- magnets, interface HW for interaction regions (IR's)
- Next steps: further participation
 - use expertise in magnet research to perform R&D on IR magnets for future luminosity increase
 - exploit U.S. expertise in Acc Phys, beam instrumentation, etc.
 - participate in commissioning, hardware & beam
- LHC Accelerator Research Program (LARP) formed
 - Formal organization, funded through DoE *via* Nat'l Labs
 - Exec Comm, US-CERN Comm, Review process, etc.
 - SLAC joins as fourth collaborator

LARP Mission

- * **Advance International Cooperation in High Energy Accelerators**
- * **Advance High Energy Physics**
 - o Help bring the LHC on and up to design performance quickly
 - o Improve LHC performance by advances in accelerator understanding and instrumentation
 - o Use LHC as a tool to gain deeper knowledge of accelerator science and technology
 - o Extend LHC as frontier HEP instrument with a timely luminosity upgrade
- * **Advance U.S. Accelerator Science and Technology**
 - o Keep skills sharp by helping to commission the LHC
 - o Conduct forefront Accelerator Physics research and development
 - o Advance U.S. capabilities to improve performance of our own machines
 - o Prepare U.S. scientists to design next generation colliders
 - o Develop technologies necessary for next generation colliders

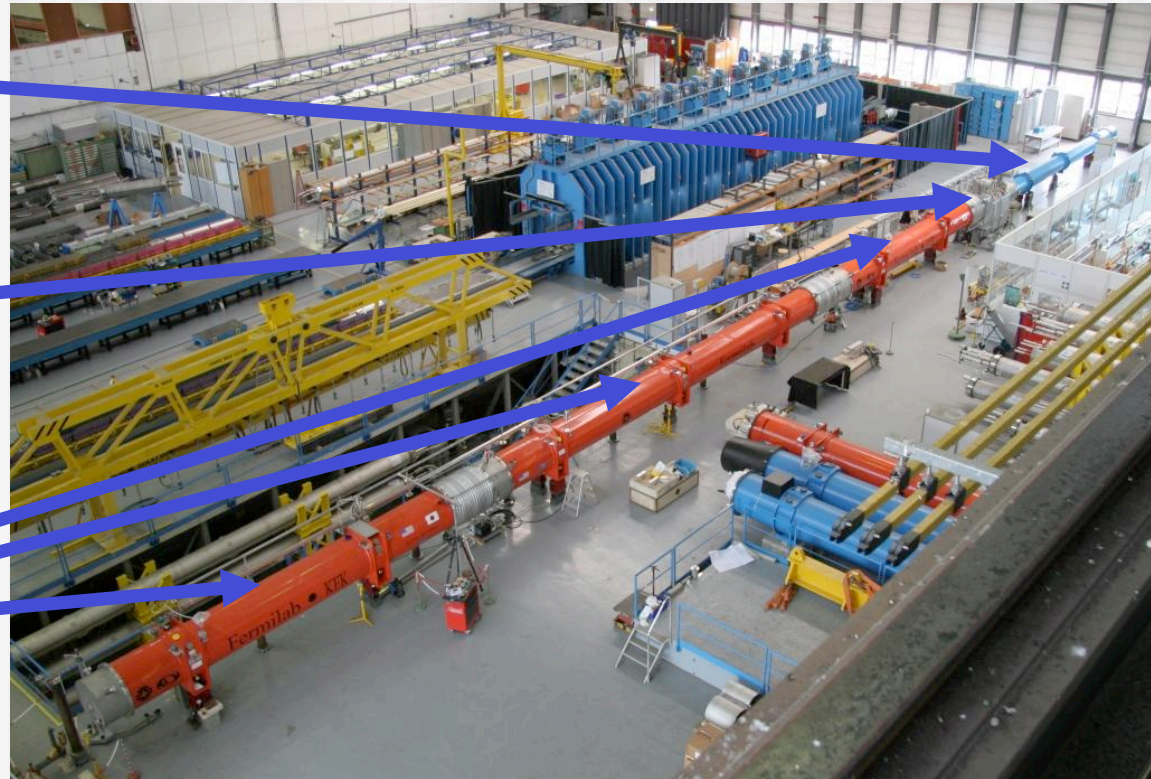
Status of US-LHC Acc. Project

- *Deliverables* have been delivered!
 - awaiting final installation, commissioning

- D1 (BNL)

- DFBX
(LBNL)

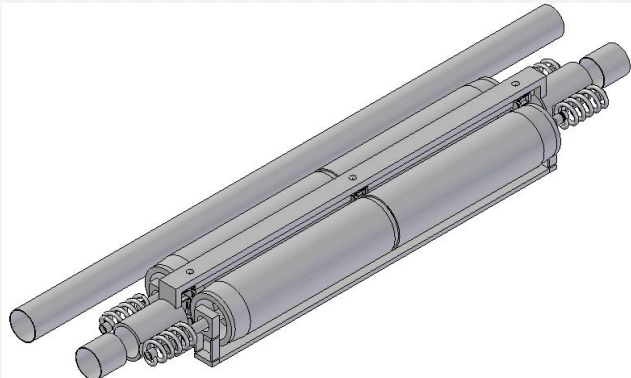
- Inner Triplet
(FNAL)



LARP Efforts

Magnet R&D

Materials/Conductor Research
Design Studies
Model Magnet Development



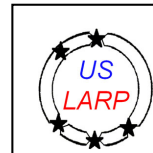
Accelerator Systems

Accelerator Physics
Instrumentation
Beam Collimation
Commissioning

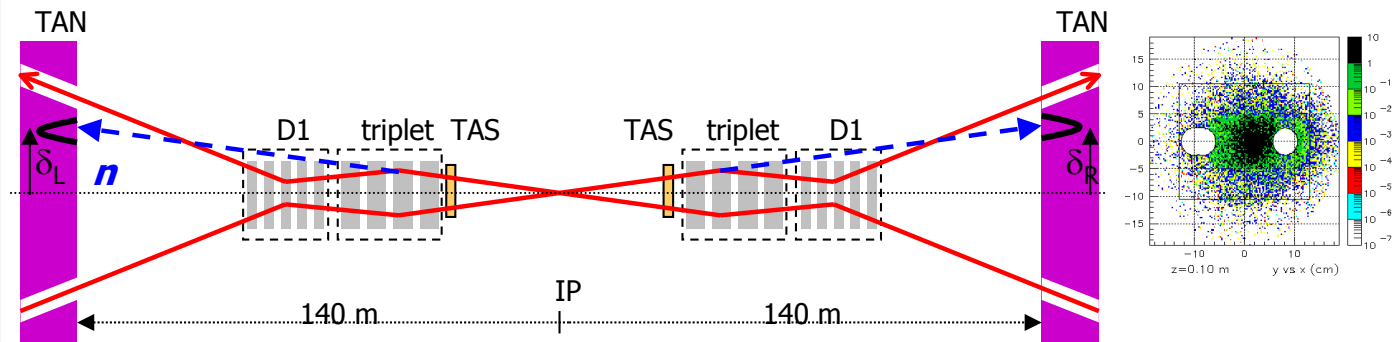
Instrumentation Efforts

Lumi Monitor development,
LBNL, BNL

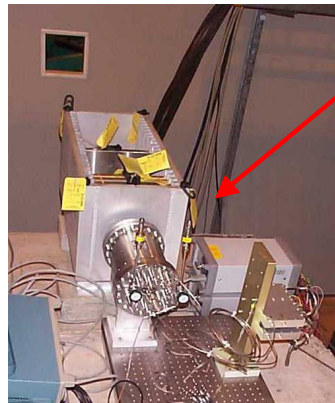
Also,
tune feedback,
Schottky monitor
+ new initiatives?



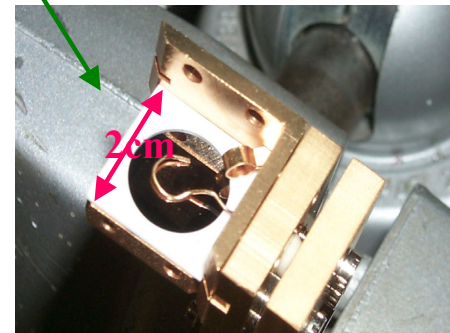
Fast Bunch-by-Bunch Luminosity Measurements



High pressure ionization chamber – Beam test in SPS 300 GeV proton beam.



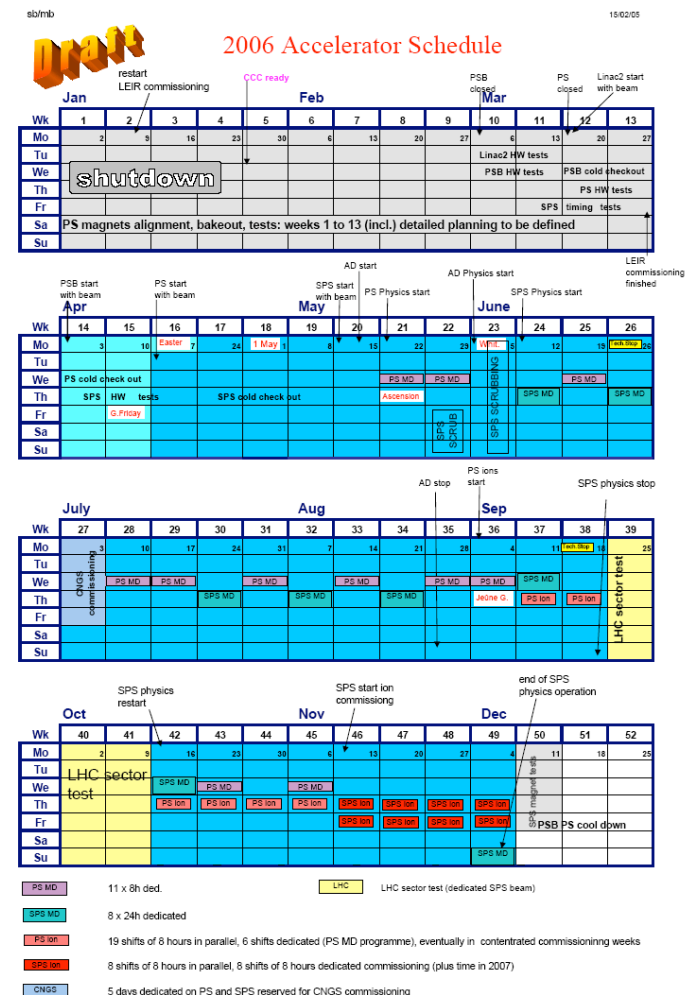
High radiation beam test of ionization chamber and CdTe detector performed jointly by US labs and CERN at the FNAL Booster



Commissioning Efforts

- Installation – in progress
- All machines off to focus on installation
- Hardware Commissioning until June 2007
- Injector Start up – April 2006
- Sector Test – late 2006 (25 September – 15 October 2006?)
 - *L.Evans added that the sector test with beam has now become an important internal project milestone, and all concerned groups should be aware of this.*
- First beam – summer 2007
- Collisions – summer 2007
- Updated installation schedule soon

■ LARP visits, ~1yr stays, have begun...



Commissioning Efforts'

- Three components to Comm. Effort:
 - a. IR = U.S. Deliverables [end of USLHC proj.]
 - b. H/W = engineering help, etc.
 - cryo, power, mechanical, ...
 - c. beam = 1st turn, optics tune, collimation, ...
 - US presence in CCC during beam commissioning

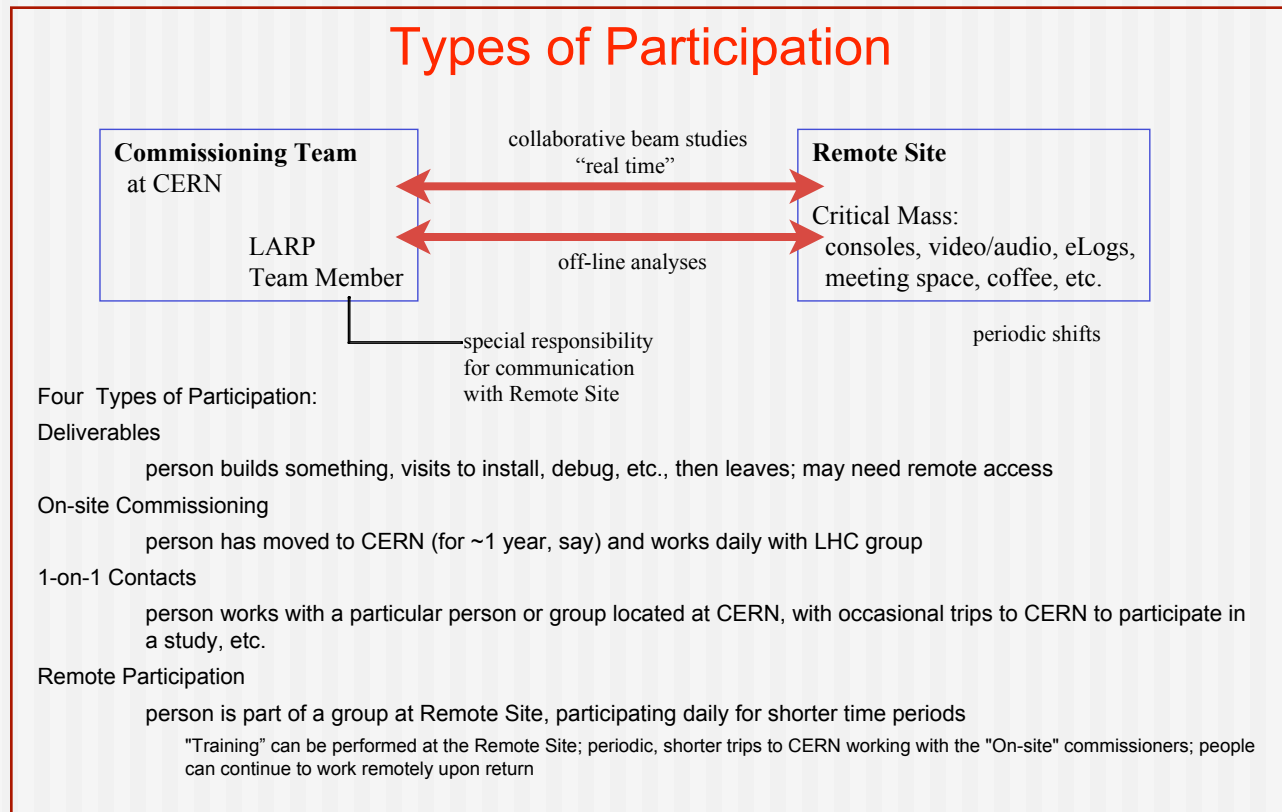
a = well defined plan, underway

c = to date, much interest from LARP; further away in time, less
organized at present

b = recent request from CERN; DoE has responded

Commissioning Efforts"

- Fermilab looking at 'remote participation' center
 - not official LARP activity, but would be *useful* ...

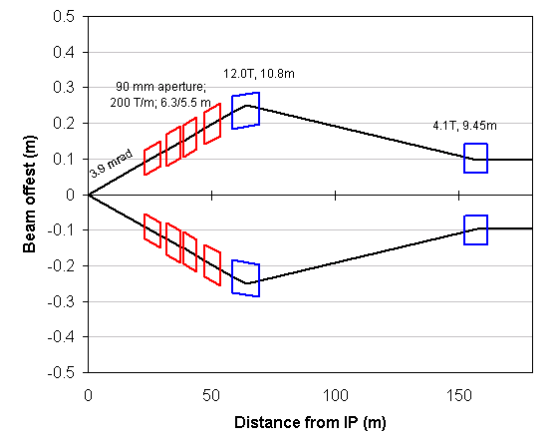
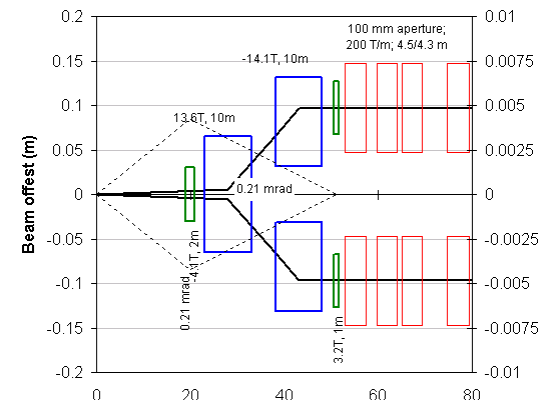
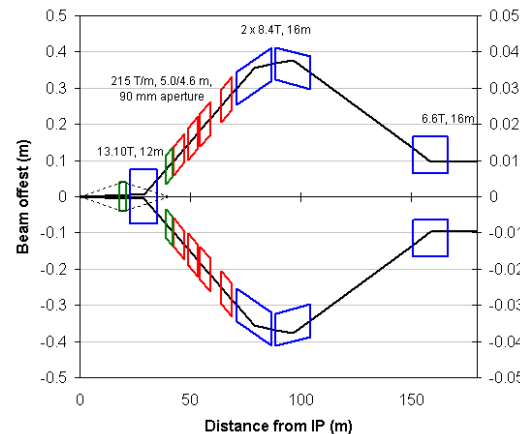
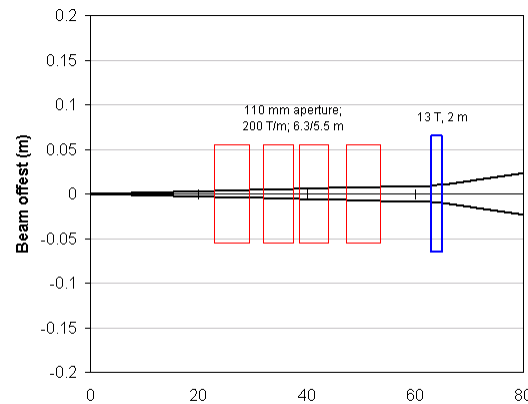


Upgrades Efforts -- IR Magnets



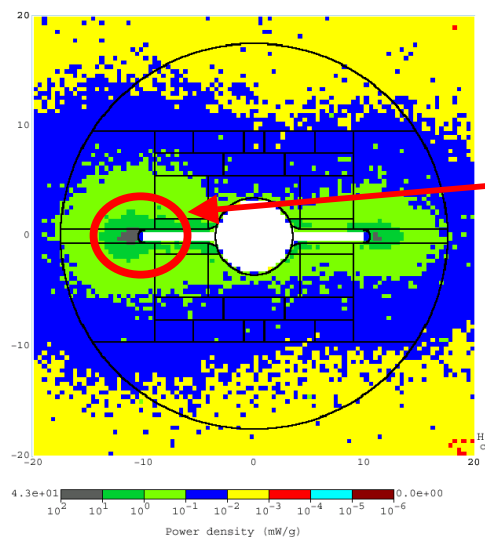
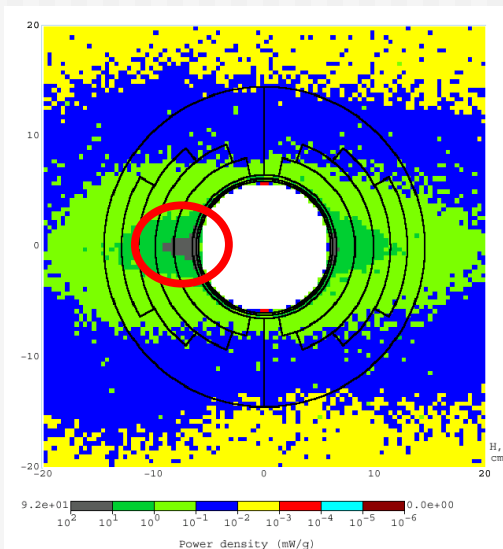
New IRs: The Major US Role in R&D for a Luminosity Upgrade

Look (now!) at cutting-edge magnet technology and R&D for future IR improvements



Upgrades Efforts -- Collimation

- Protecting LHC components at ever-higher luminosity (intensity) requires energy deposition calculations, studies of renewable collimation devices

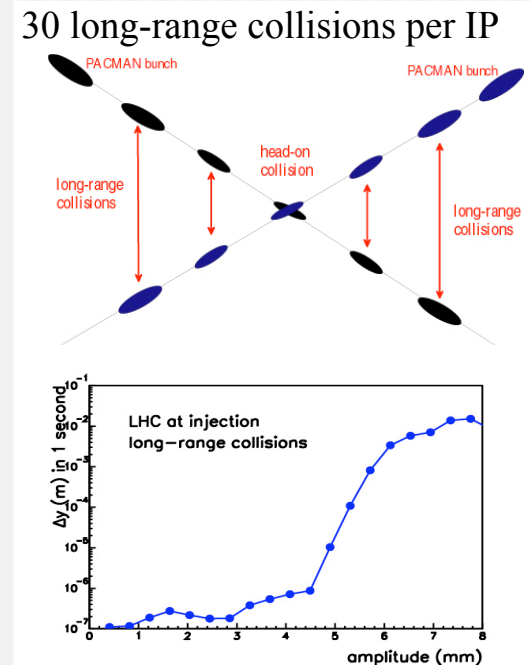
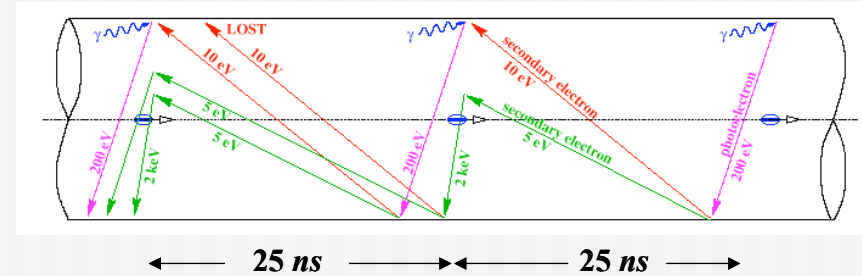


Major challenge is high radiation load.

- Peak power density 50-100 x that in baseline quads at $L=10^{34}$.
- Total power >3kW per magnet!

Upgrade Efforts -- Accelerator Physics

- Electron Cloud ...
-
- Energy Deposition
- IR Optical Design Upgrade
- Beam-Beam interaction, compensation ...



LARP Organizational Structure

US LHC Accelerator Research Program (LARP) Organization Chart

September 22, 2005

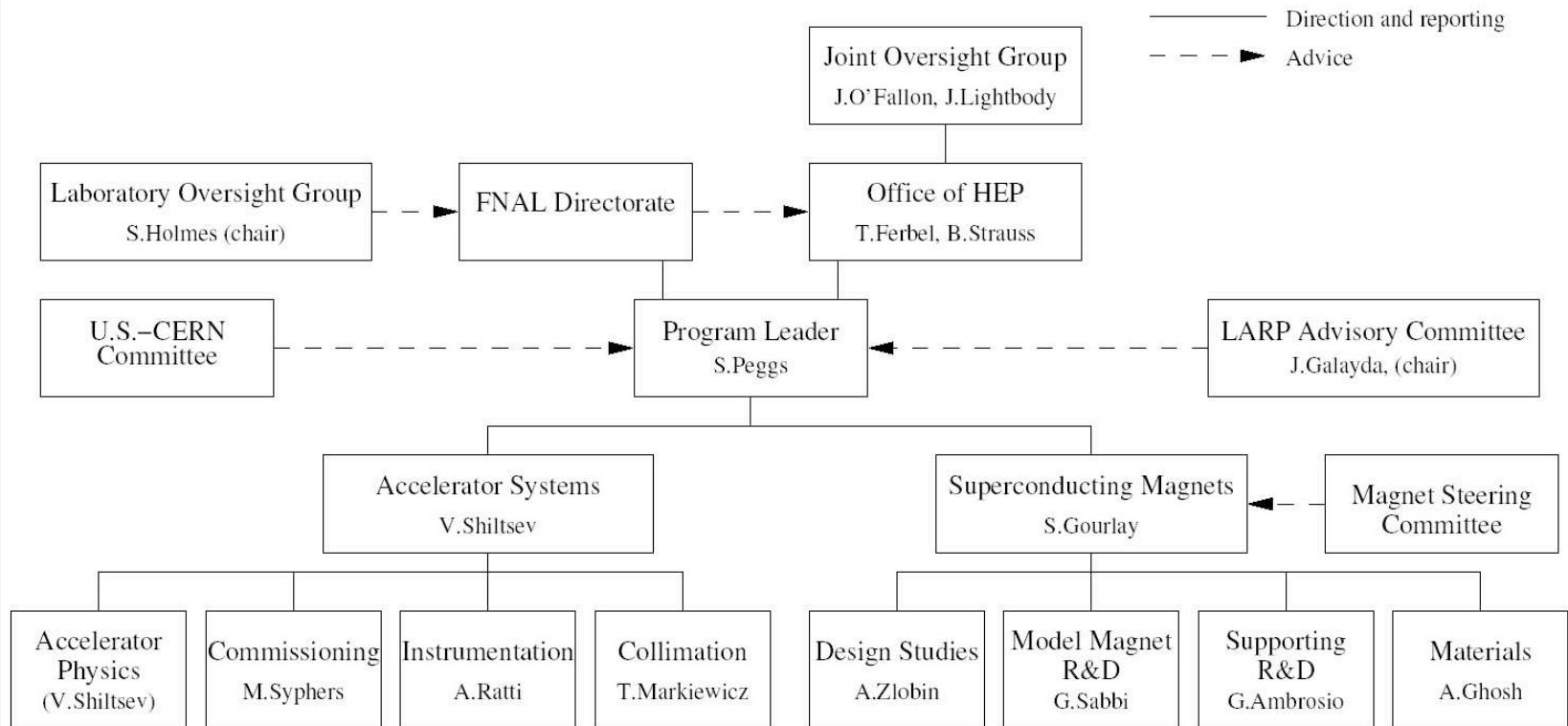
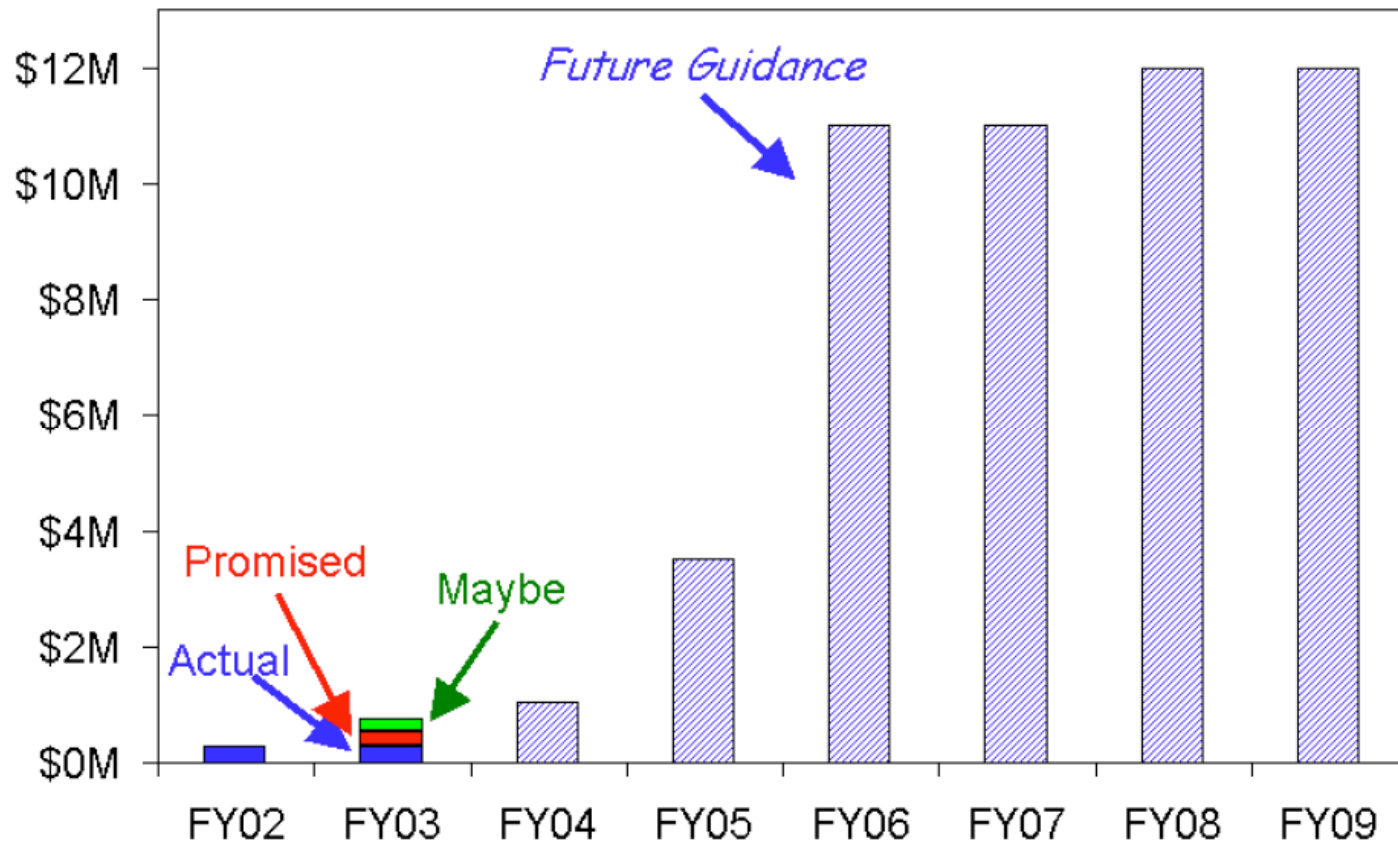


Figure 1: Organization of the LARP advice and direction structure, including advisory committees (July 1, 2005).

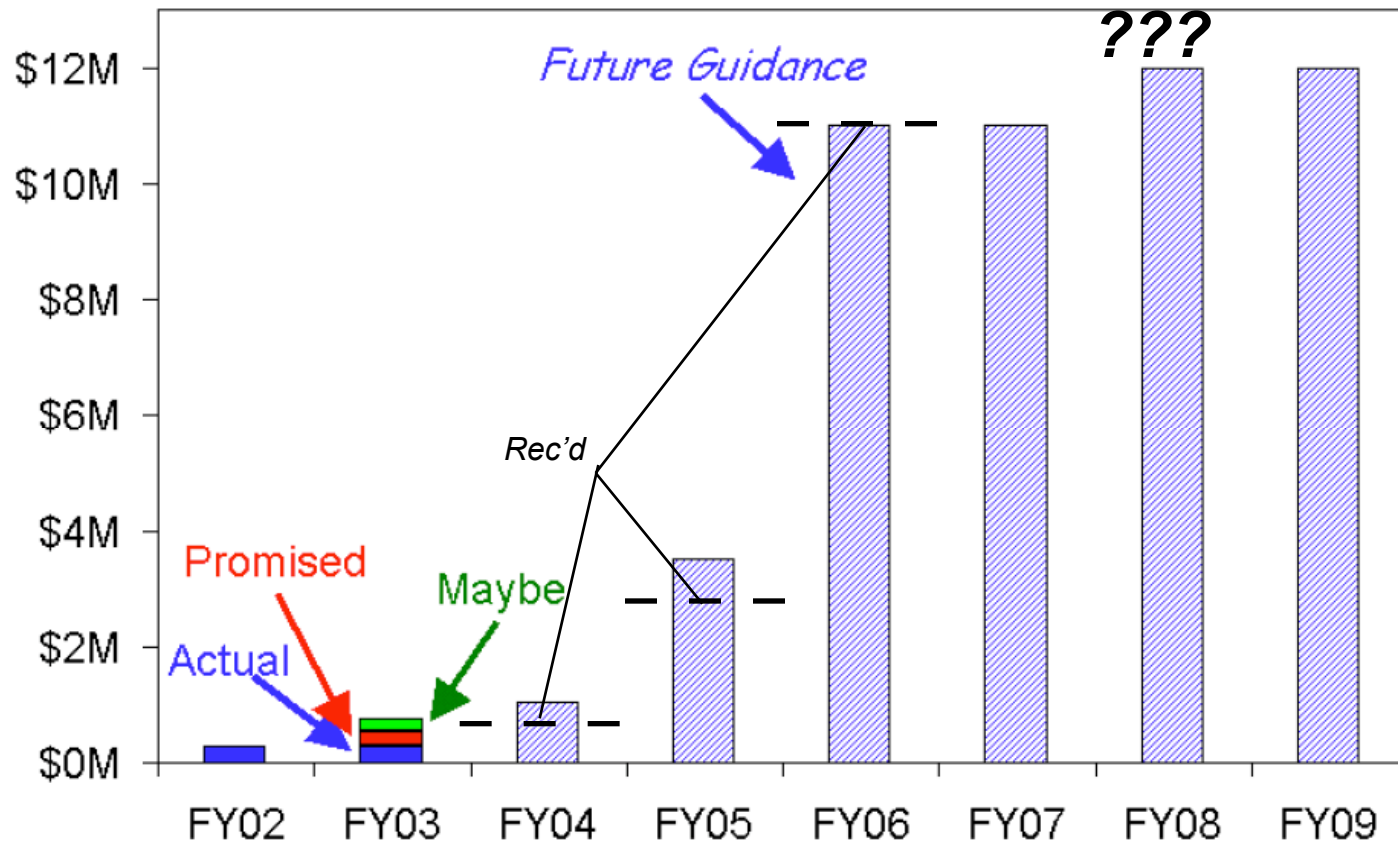
Funding

2003 Projections:



Funding

2003 Projections:



Toohig Fellowships


■ LARP-sponsored Fellowships for recent PhD's --

First recipient recently accepted

more to come...

**Toohig Fellowships
in Accelerator Science at the LHC**

The U.S. LHC Accelerator Research Program
is pleased to announce the Toohig Fellowships for recent
PhDs in science, technology and engineering interested
in pursuing studies in accelerator science.




Dr. Timothy Toohig, J was a physicist and journalist who devoted his life to promoting academic science and increasing understanding among scientists of all nations and disciplines.


Fellowship recipients will participate with U.S. scientists in the commissioning operation and other activities designed to understand the LHC.

Toohig Fellowships last for two years, renewable to three. Approximately equal time will be spent at CERN and a U.S. DOE laboratory.

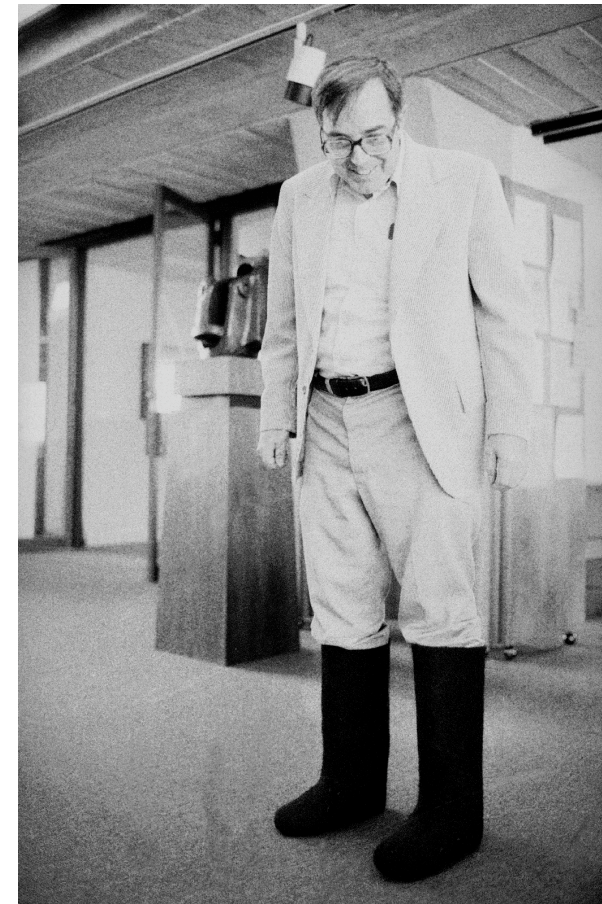
Applicants should send a current curriculum vitae and three references to Peter Lisman (plisman@fnal.gov) or Steve Boggs (sboggs@fnal.gov).

You will find information about the Fellowship and LARP at
<http://www.toohigfellowship.org>

 Office of Science
U.S. DEPARTMENT OF ENERGY

 DOE

LARP is a U.S. DOE program and is an equal opportunity employer.



Summary

- LARP is U.S. national effort to provide on-going support of LHC
 - organized, funded, evolving
 - important for future, as large-scale international projects hard to come by; must take advantage, gain experience
- Toohig Fellowships provide conduit for future bright accelerator physicists to participate

visit: <http://www.agsrhichome.bnl.gov/LARP/>